
GENERAL DYNAMICS
Land Systems


General Dynamics Land Systems
General Dynamics
Corporation

General Dynamics Land Systems
Sterling Heights Complex

38500 Mound Road
Sterling Heights, MI 48310-3200 USA

General Dynamics Land Systems
Embedded Military Systems

- Armored Vehicles
- Advanced Vetronics

- Engineering Services
- Logistics Support

General Dynamics Land Systems

M1A2 Main Battle Tank and Derivative Vehicles

- Ada 83/95
- Data Bus
- Power Bus
- VxWorks
- Hard Real-Time

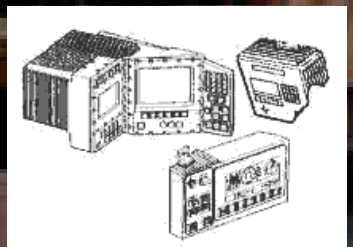
- Motorola 680x0
- PowerPC
- 1553B/FDDI
- VME
- Fault Tolerant

Vetronics Software Architecture

CORE Architecture for Typical Vehicles

Distributed Electronics System Architecture

- 6 LRUs with ~15 General Purpose Processors
- 3 Crew Stations
- 2 Redundant Mission Computers
- 1 Vehicle-Specific Integrated Control System



Microsoft VFW

Intra-Vehicle Networking

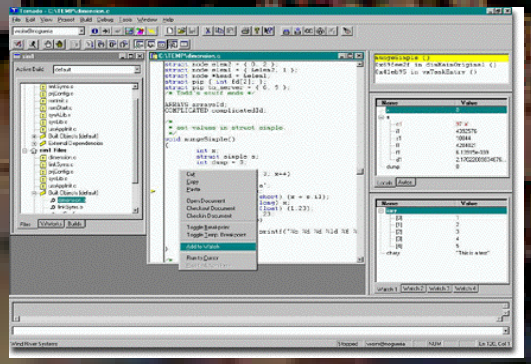
- VME
- MIL-STD-1553B
- GDLS Developed (Now COTS)
  - Utility Bus
    - Power Management and Device Control
- CAN Bus and FDDI in Some Systems

Vetronics Software Architecture

CORE Architecture for Typical Vehicles (Cont'd)

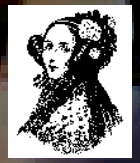
System Software

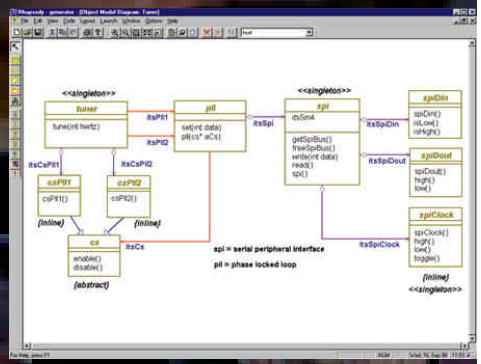
- VxWorks RTOS and Tornado II
- X-11 Based Graphics



Application Software

- 200K SLOC of Application Software
  - Predominantly (Rational) Ada
  - Some C/C++ and Assembler





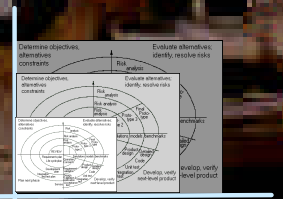
Vetronics Software Architecture

Challenges in Development of Next Generation Software Systems

Program Execution

- Reduced Cycle-Times
- Fluid Workforce

S/W Life Cycle



time

Technology

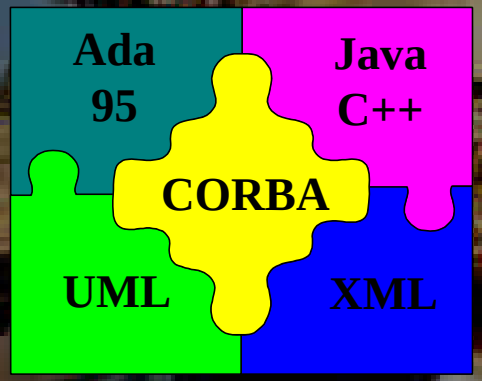
- More Heterogeneous System
  - Languages
  - Operating Systems
  - Processors
- Increased Requirements for
  - COTS S/W Reuse
  - 3rd-Party Software Integration

Vetronics Software Architecture

CORBA is a Key Element in Our Software Technology Plan

Software Reuse

- Improved by Component Based Development (CBD) Techniques
- Adopting Interface Centric Component Design



Integration Technology

- Gluing Together Diverse Components
- Standards Based
  - Broad Industry Support
  - Addresses Staffing and Tool Availability

Complimentary Technologies

- Java
- eXtensible Markup Language (XML)
- UML -Based Modeling


Vetronics Software Architecture
Advantages of CORBA for Next Generation Vehicle Architectures
Advantage #1
• As a Simplified Means for Developing Systems Using Multiple Programming Languages
• Ada 95
• C/C++
• Java
• Improves our Ability to Use Best Language & Tools
• Ada 95 for Real-Time Mission Critical Software
• Java for Display Software
• C/C++ Autocode Output from Modeling Tools


Vetronics Software Architecture
Advantages of CORBA for Next Generation Vehicle Architectures
Advantage #2
• Reduction in Amount of Custom Communication S/W
· Reduces Time to Market by backend Maintenance Compression
• Improved Productivity (Fewer SLOC per Unit of Functionality)
• Eliminates a Class of Custom Software
· Typically Complex and Error-Prone
• Effectively Delegates Maintenance/Enhancement to Domain Expert Vendors
• Reduces Staffing Dependencies


Vetronics Software Architecture
Advantages of CORBA for Next Generation Vehicle Architectures
Advantage #3
• Integration of COTS and 3rd-Party Software
• Use of IDL for Defining External Interfaces
• Platform Independence (OS, Languages)
• Dynamic (Re)configuration on-the-fly with Java Solution
Advantage #4
• Support for Modern Development Practices
• Component-Based Development
• Object-Oriented Design
• Design Patterns
• Legacy Refactoring


Vetronics Software Architecture
Advantages of CORBA for Next Generation Vehicle Architectures
Advantage #5
• Migration Path
• CORBA Components facilitates Multi-Protocol Components
• Component Software PnP allows Integration Automation


Advanced Vetronics Software Architecture
Object Management Group - Economy of Scale
Object Management Group
• Over 800 Companies in the Consortium
• Worldwide Standards Development
• Alignment with ISO (for UML)


Advanced Vetronics Software Architecture
OMG CORBA Success Stories
Paranor AG KingCat M270
• Marine Vehicles
· Ada 95, Java & OIS CORBA Solution
Boeing WSOA and UAVs
• Weapon System Mission Processing
· Ada 95 & OIS Ada 95 CORBA and TAO C++ CORBA
Lawrence Livermore National Labs NIF
• National Ignition Facility
· Ada 95 & OIS CORBA Solution
General Dynamics Land Systems
• Future Systems
· Ada 95, Java, C++ & OIS CORBA Solution

Vetronics Software Architecture

Overview of a GDLS Notional CORBA-Based Vehicle Architecture

Development of Device Control Logic Using UML

- Leverage Modeling Tools, e.g. I-Logix Rhapsody
- Integration of C++ Auto-code Using CORBA

Java Display Client

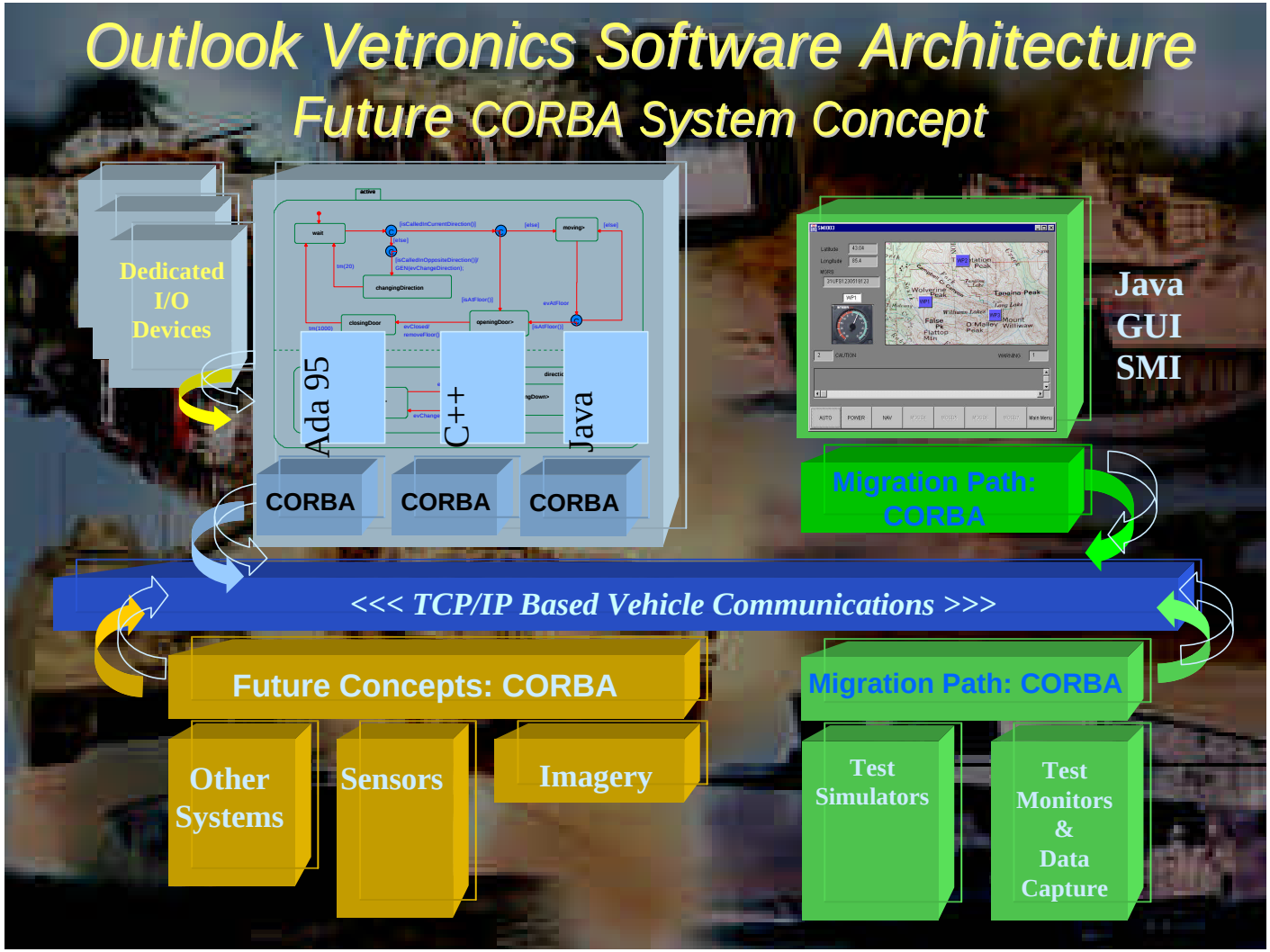
- Dynamically Generated Screens Using XML-Definitions
- CORBA-Enabled JavaBeans

CORBA-Based Interprocess Communication

- Multiple ORBs (Prototype Used *JavaIDL & Visibroker*)
  - ORBexpress Planned for Ada/C++ in Deployed System
  - Selection of Java ORB for Target Still In-Process
- CORBA Name Service
  - Used for Client/Server Component Discovery Process
  - Common File Method Used

Outlook Vetronics Software Architecture

Future CORBA System Concept

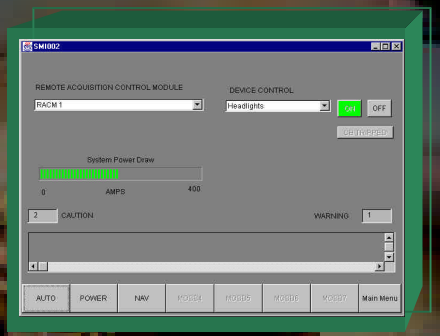


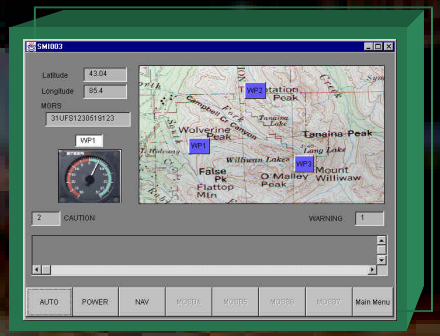
General Dynamics Land Systems

Driver's Station Concept Requirements

Common Functionality across Land Vehicle Designs

- Soldier Machine Interfaces (SMI)
- Gauges, Indicators, Maps and Situational Awareness





Automotive

- Fuel Levels
- Engine Status
- Compass Rose
- Cautions/Warnings

Power Management

- Power Controls
- Power Draw
- Load Status
- Alerts

Navigation

- Steer-To Indicator
- Digital Maps
- Waypoint Navigation
- GPS


Vetronics Software Architecture
GDLS Work to Date
Development of Architectural Design Patterns
• New Start Programs
• Emphasis on Architecture and Design
• Deferred Specific ORB and Implementation Issues
• Most Prototyping on Host Systems (Windows and Solaris)
• Feasibility Investigation of Legacy Systems
Replacement
• Existing Transport Software
• Currently Performing Sizing and Timing Analyses

Vetronics Software Architecture

Watch Items and Areas Requiring Further Work

Watch Items

- Target Memory Requirements
- In-Process vs. Inter-Process Interfaces
- Throughput
  - Processor and Memory Architecture vs. VME Capacity
  - System Communication Mechanisms and Quality of Service

Processor Mhz
Flash FootPrint
Socket Resources

Areas Requiring Further Work

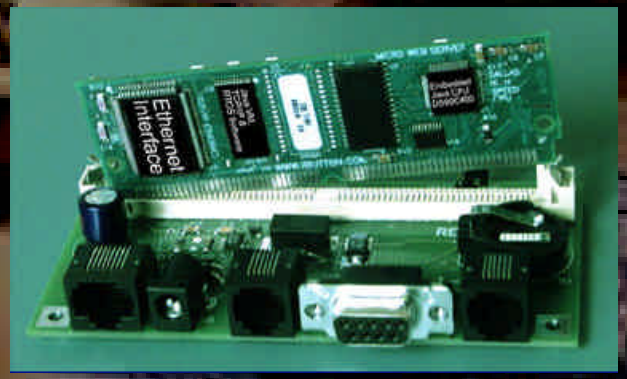
- Naming Service Discovery Techniques
- Use of Non-TCP/IP Based Transports
  - e.g. MIL-STD-1553B
- Use With Non-OO Legacy Software

Advanced Vetronics Software Architecture

Commercial Embedded Java

Dallas Semiconductor

- **Digital Decoder Rings**
- **Java Cryptography**
- **Tiny InterNet Interface**
  - **Small footprint JVM**
  - **Ethernet (TCP/IP) Interface**
  - **CAN Interface**



Advanced Vetronics Software Architecture

Embedded Personal Java with Real Time Support

Esmertec

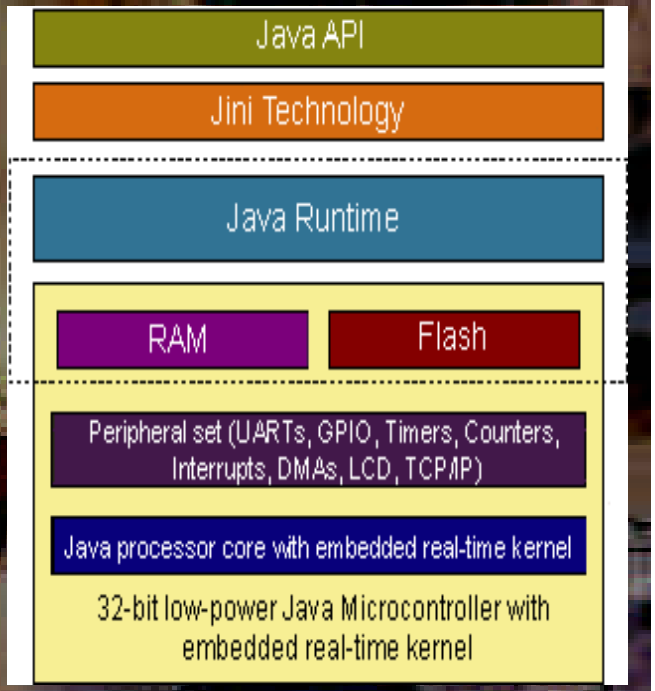
- **Embedded JVM + RTOS**
- **Java Dynamism Support**
- **Personal JVM and Micro Edition**
- **Real-Time Support Extensions**

Advanced Vetronics Software Architecture

Embedded Real Time Java - aJile Systems

aJile Systems

- RTSJ Compliance
- Multiple JVM Support
- JEMCore on-a-chip

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Warmly Thanks the
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